Dark Horizon

Airpower Revolution on a Razor's Edge—Part Two of the "Nightfall" Series

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> *The aviators accepted the robots, as servants, into their house, not because they liked them or even understood them, but because neighbors had eagerly bid for their ownership. The robots, however, kept challenging the boundaries.*
>
> —Carl Builder, *The Icarus Syndrome*

The release of "Nightfall: Machine Autonomy in Air-to-Air Combat" in the May–June 2014 issue of *Air and Space Power Journal* generated substantial conversation about the future of airpower, reaching across the Air Force, the joint team, and the defense industry.[1] Achieving the end states and national advantage proposed by "Nightfall" requires an articulation of airpower theory and a committed

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institution. Consequently, this second article in a planned series addresses the organization of today's precursors that bear the title "remotely piloted aircraft" (RPA) employed by Air Combat Command, Air Force Special Operations Command, and various other government agencies.[2] As Colin Gray observes, no weapon is strategic in and of itself but is merely a means for the construction of an actual strategy.[3] Nevertheless, RPAs in the hands of coalition forces and other government agencies have done much to reverse the calculus of global counterinsurgency in favor of organized states.[4] Perhaps most telling of all are moments when insurgents beg for a fight but then offer a caveat regarding the invitation by asking for relief from robotic aircraft.[5]

This article introduces a brief sketch of emerging theory to demonstrate how remote and autonomous capabilities are not merely an answer for niche contingency operations but central to the unfolding narrative of humanity's experience with airpower and of key importance to unlocking new insights into its fundamental nature. As multiple media sources have highlighted, however, pressures on Airmen in the RPA enterprise have reached crisis levels. For that reason, this article investigates the community to understand the exodus of talented, highly trained professionals who might have otherwise shaped the next chapter of Air Force history from within.[6] Research methods included surveying 114 pilots and sensor operators from the MQ-1, MQ-9, and RQ-170; conducting several direct interviews; and inspecting records to corroborate assertions.[7] One limitation of the study was a lack of access to RQ-4 users or a non-RPA control group. Because respondent views were sometimes emotionally charged, each section reports firsthand sentiment analysis and then a potential alternative explanation or parallel set of circumstances that occurred elsewhere in the service. The study found three major causes for the exodus: the well-advertised overwork, a service culture with an overt bias toward traditional aviation, and institutional reluctance to plan or provide for these Airmen's attempts to improve their circumstances. The article offers suggestions to posture the Air Force to behave responsively to joint force needs and to better leverage the advent of robotic airborne systems.

Predicament

Since 11 September 2001 (9/11), demand for intelligence, surveillance, and reconnaissance (ISR) has been insatiable. The service's efforts to meet ISR requirements to fight a globally distributed extremist network contend with other problems: aging aircraft fleets in other mission sets, an international financial crisis, and tight federal budgets. Increased reliance on robotic aircraft during this period created a dilemma for accepted Air Force doctrine and culture: satisfying joint force needs predominantly required systems that remove or reinvent many of the familiar elements of aviation and present unknown viability for future conflicts. This tension translated into spectacular fighting between the Air Force and Secretary of Defense Robert Gates as they exchanged alternating accusations of "current-war-itis" and "next-war-itis."[8] The proliferation of RPAs as an answer for ISR made the former iconic of the latter, potentially convoluting means and ways in discussions of either topic. To be clear,

decision makers want information superiority and thus drive the increased demand for ISR, much of which the Air Force must supply, while RPAs are one *mechanism* to satisfy that requirement in unprecedented volume.

It is possible to prepare for both present and future styles of warfare for which the Air Force finds itself responsible, but doing so may require thinking as broad as Gen Thomas D. White's willingness to set aside the cockpit—and in more missions than reconnaissance.[9] Yet, the resistance that General White found in his era, the observations of Carl Builder decades later, and the tension that Secretary Gates perceived whenever any of them explored alternatives to the cockpit all suggest that the Air Force has enduring institutional preferences for human-inhabited air vehicles and an unwritten hierarchy among its core competencies. Such predilections are not just a cause of political strife but a mechanism for potentially undervaluing contextually relevant perspectives on the design and use of airpower. In contemporary context, both state and nonstate threats are significant, the aerospace industry is undergoing a revolution in the development of remote and autonomous systems, ISR demand continues to grow unchecked, and yet the Air Force's top acquisition priorities remain human-inhabited systems intended to recapitalize well-understood missions around which the service has organized itself.[10] One need no more complicated a litmus test than to pose this hypothetical question: if recapitalizing RPA systems, infrastructure, and organization to meet urgent needs in the joint community would mean giving up one production lot of F-35s over the next decade and no alternative trade-offs were possible, which would the Air Force voluntarily elect?

In his book *Tomorrow's Air Force*, Jeffrey Smith observed that organizational changes occurred in the service's history when communities brought situationally appropriate capability forward while a dominant community did not.[11] Among all power-projection options, airpower's marriage to technology seems the most extreme and nuanced, and large, upfront investments needed for research and development mean that the Air Force has a particular interest in adapting itself and picking appropriate systems well *before* conflicts arrive. Builder asserted that the service abandoned deliberate development of airpower theory, yet it is clear that when it enacted that discipline, the Air Force enjoyed incredible successes.[12] For example, consider the impact of John Boyd's and John Warden's theories on system design and operational planning, respectively, that undergirded coalition conduct in Operation Desert Storm. Airpower theory is not an abstract luxury: it is today's requisite down payment for winning tomorrow's wars.

Dimensionality

Today's Air Force has no formal, published theories about remote and autonomous airpower, so this section defines two key terms and a construct for predicting success in combat amidst increasingly sophisticated and interdependent autonomous capabilities. Let the term *combat automation* in the context of airpower mean "the transfer of a task normally performed by an operator of a military aircraft to the control of an automated system, typically a digital computer." Further, let the term *emergent combat automation* (ECA) in the same context signify "the advent of a new tactical

capability as an *emergent property* of the interaction between integrated automation systems." Devices like autopilots and modern navigation systems are examples of combat automation—computers do some mental or physical task to allow crews to concentrate on other responsibilities and preserve situational awareness, and the notion is well understood. Conceptualizing ECA, however, requires a shift in thinking.

Today's system-design concepts tend to assume a human pilot making decisions about how to engage the enemy. If one removes the human from the equation, instead directing that pilot to provide commander's intent to an onboard machine pilot and monitor its performance, a new set of possibilities emerges. Consequently, the almost comical question "If two robotic airplanes with the same software and processing power fought each other, which would win?" is actually a modern restatement of a need to understand how to predict success in combat when the rules are unclear. Boyd's two chief discoveries—the observe-orient-decide-act (OODA) loop and energy maneuverability (E-M) theory—codified such rules in an era when it was safe to assume that human decision making would be central to the engagement.[13] When comparative OODA and E-M differences become negligible between two highly automated warplanes (or between a warplane and applicable segments of an air defense system), however, a larger framework is necessary to make reliable predictions. The key to such a framework amidst evolving system complexity lies in permitting flexible definitions of dimensionality.

Although four dimensions of space-time are intuitive, physicists conceptualize extradimensionality, computer scientists use "n-dimensional" arrays of variables, and analytic data warehouses often have "star topology" with arbitrary dimensions.[14] A dimension could be any property of an aircraft that presents tactical impact, and some may be derivative values of other dimensions—for example, the frequency range or power available in an electronic warfare module or that module's frequency switching rate (a derivative with respect to time), the vehicle's available g-loading about a particular axis (integrating E-M considerations), the number of targets it can track simultaneously, the spectral or spatial resolution of its sensors, and so forth. To represent OODA using the framework, define an arbitrary dimension for "computational throughput" (the machine's version) or "useful thought" (the human's), and consider it with respect to time.[15] We might refer to this framework as a dimensional theory of airpower and note that Boyd unlocked two of "n" possible dimensions that may be predictors of victory. The two key tasks of dimensional theory are to identify relevant dimensions and then to mathematically express the possible relationships between dimensions. A logical use for the framework involves conducting simulation and analysis whereby artificial intelligence applications may search out ways to exploit the mapped dimensions and discover how emergent properties create novel tactical options.[16] Uncovering such properties for an autonomous aircraft to act upon provides a "third offset" advantage and reveals things a machine can do that a human cannot.[17]

This approach has two important implications. First, under these definitions of automation in airpower, systems like the F-35 are monuments to combat automation but have no concept of ECA—even perfect situational awareness is still limited by human cognition and becomes irrelevant if the machine has considered dozens more dimensions upon which to formulate tactics.[18] ECA goes beyond asking machines to

do the "dull, dirty, and dangerous"; instead, it discovers what they can accomplish *past* human abilities. Second, this perspective surfaces only upon the serious consideration of computationally capable robotic aircraft but reveals something about airpower in general and how to structure arbitrarily complex warfare simulations that incorporate both human-inhabited and robotic aircraft. The answer to the question about which robot wins the fight is likely to be remarkably similar to Boyd's: the one that is better prepared and equipped and that encounters opportunity first. The same holds true for which of two modern air forces would defeat the other, but essential to preparation is a realization that remote and autonomous approaches to airpower cannot reach their potential if relegated to supporting traditional pilot-centric models. Instead, they are the next chapter of unfolding discovery; as such, they are unavoidably an affront to the Air Force's demonstrated institutional preferences—a reality with tangible consequences for Airmen today.

Fratricide

The extent of overwork and understaffing at RPA units is well documented, but this study found that chronic overwork accounted for only one-third of the categorical causes for an exodus of RPA pilots. The other two contributors were cultural resistance and the perceived powerlessness to take charge and improve their circumstances. With respect to culture, Smith articulated that the fighter-operations perspective still dominates the service although it is losing momentum.[19] A parallel theme in this article's research concerns the respondents' belief that the dominant culture behaves in a nepotistic manner to preserve power and stereotypically disdains the RPA community. A general RPA impression of fighter culture would ascribe to it a heuristic for self-serving bias in this pattern: *The business of the Air Force is flying airplanes to win wars. Those who fly best are most qualified to lead the Air Force. Fighter pilots are the best pilots; therefore, it makes sense that they lead the Air Force.* Correlating to this perception, Smith's study found that fighter respondents stood alone in their belief that fighter pilots were best suited for senior leadership roles and that RPAs should be the lowest budget priorities—other officers overwhelmingly held opposite views.[20] If it truly is the case that some officers make sense of their place in the service by a biased heuristic, then it is important to note that the failures in this line of thinking are numerous. The most critical misstep is a reversal of ends and ways as Builder examined two decades ago.[21] The business of the Air Force is *actually* to deliver airpower for the nation, which may or may not involve an aircraft—let alone one inhabited or manually operated by a human. Leadership is furthermore both self-evident and self-sacrificing rather than an entitlement.

Smith's work revealed a historical trend for dominant cultural perspectives to suffer logical disconnects in times of transition. Officers flying fighters responded to Smith's survey by affirming their belief that future conflict is more likely to be irregular than conventional, but in subsequent questions they disagreed with any actions to reprioritize Air Force spending for the threat they themselves had identified.[22] Ty Groh's research at Georgetown University affirms that large, well-established states that cannot afford direct confrontation turn to (often irregular) proxy wars, and that

insight seems particularly relevant in the present geopolitical order.[23] Corresponding survey data for this article found that a significant number of RPA pilots felt that the Air Force, dominated by fighter-operations perspectives, treated them unfavorably despite extensive combat successes (fig. 1).[24] Among several disturbing comments, one pilot stated that "other pilots scoff at RPAs. I remember the look of [an] F-15C pilot when I told him I flew RPAs, and he looked at me like I was some kind of leper—not remorse but almost disgust. He was a friend, but I don't consider him one now that he did that to me."[25] The prejudice and the reciprocal unwillingness to forgive are both clearly destructive, potentially inhibiting either party from seeking out war-fighting integration opportunities. If there is animosity, alternative reasons may include frustration over the post-9/11 combat environment not matching the expected challenges for which many fighter pilots diligently trained and organized themselves (a reduction in mission satisfaction compared to a better-understood conventional war)—or perhaps that the Transformational Aircrew Initiative for the 21st Century, which involuntarily pulled fighter and bomber pilots to the Predator program, imprinted a negative sentiment regarding the RPA.[26]

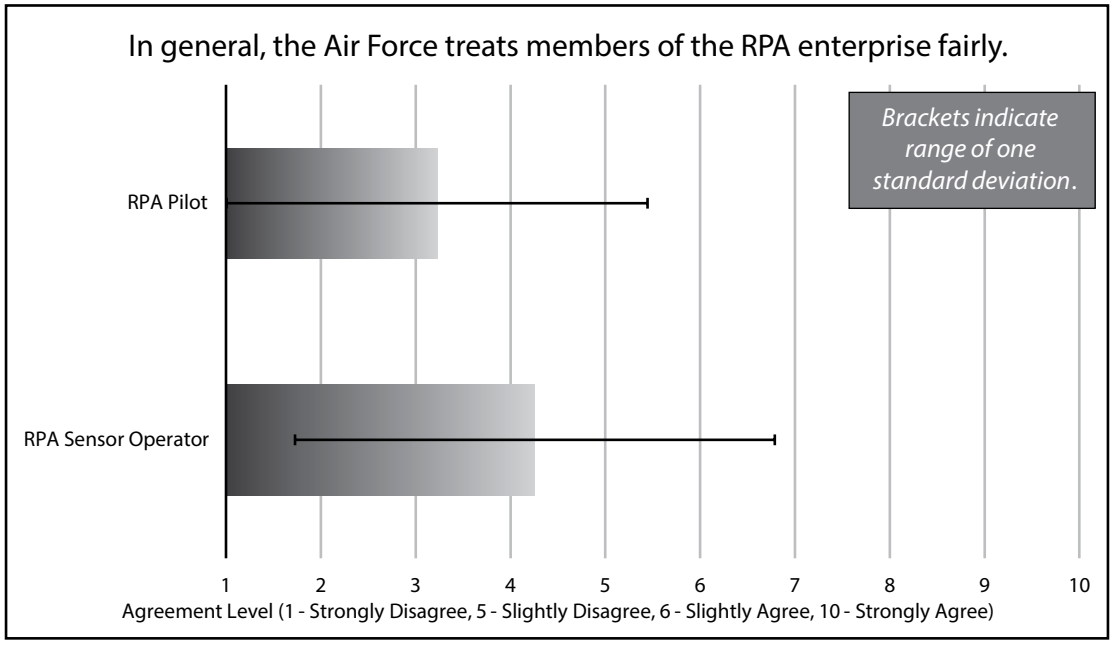

Figure 1. Perceptions of mistreatment

It is equally important to acknowledge that as a consequence of commanders often sending their least-competitive officers, the enterprise did start, as Houston Cantwell reported, like a "land of misfit toys."[27] The community has now formed a nucleus of high-performing teams that continually raise the community's standards, but changing perceptions requires time, consistent performance, and advocacy. Intraservice

squabbling, however, conceals the emergence of a *new airpower perspective of globalized operations-intelligence fusion* developed over 15 years of sustained combat. In line with Stephen Rosen's point that those who carry an innovative perspective forward must rise through the ranks for the institution to fully leverage it, the exodus of RPA pilots is of particular concern in terms of the service's ability to transform itself.[28] Members attending a chief of staff of the Air Force (CSAF) roundtable at Creech AFB, Nevada, noted that his desire to fix the low inflow of RPA pilots, accepting inevitable attrition, shows concern for force sustainment but not transformation.[29] Surveys and interviews indicate a corresponding belief among RPA Airmen that they are as desperately needed as they are unwanted.[30] Whereas Gen Mark Welsh said he saw clear potential for an 18X (RPA-only pilot) to lead the service one day, community sentiment is far more pessimistic (fig. 2).[31]

However unintentionally, a number of oversights in basic policy design fuel perceptions of inequity. For example, when RPA crews are in-theater to launch and recover their aircraft, even using them to defend the base amidst incoming enemy fire, the crews' flying time is downgraded from "combat" to "combat support," but all inhabited aircraft overhead (crews not enduring the rocket attack) receive combat hours and earn upgraded medals.[32] If RPA crews switch to the Air National Guard or Reserve, protections of the Uniformed Services Employment and Reemployment Rights Act extended to other aircrews do not address the "deployed-in-place" reality.[33] In 2012 disproportionately low RPA promotions even drove a congressional investigation.[34] An April 2014 Government Accountability Office report confirmed that advancement hovered among the lowest levels in the service from 2006 to 2013. One nuanced detail affecting competitiveness is the number of people assigned to a single wing. For example, in 2013 over 570 company grade officers were on Creech (almost three times the total number of officers on Holloman AFB, New Mexico), severely limiting the number of leadership positions, awards, and stratifications available.[35] The Air Force instructed selection boards to contemplate the fact that the circumstances of RPA organization and workload might mask the leadership potential of officers being considered for promotion and allocated 46 in-residence school spots for the 2012 board.[36] Although promotions improved, by the 2014C majors' board, only nine RPA pilots were selected for in-residence schooling, one of whom was actually an F-15 pilot set to return after an RPA tour (7.5 percent effective selection). By comparison, 47 fighter pilots (24.1 percent) received school selection from the same board.[37] The Government Accountability Office highlighted that the Air Force did not assess the mechanisms actually responsible for selection patterns, but closer inspection of both what is absent and what is present in records yields clues.

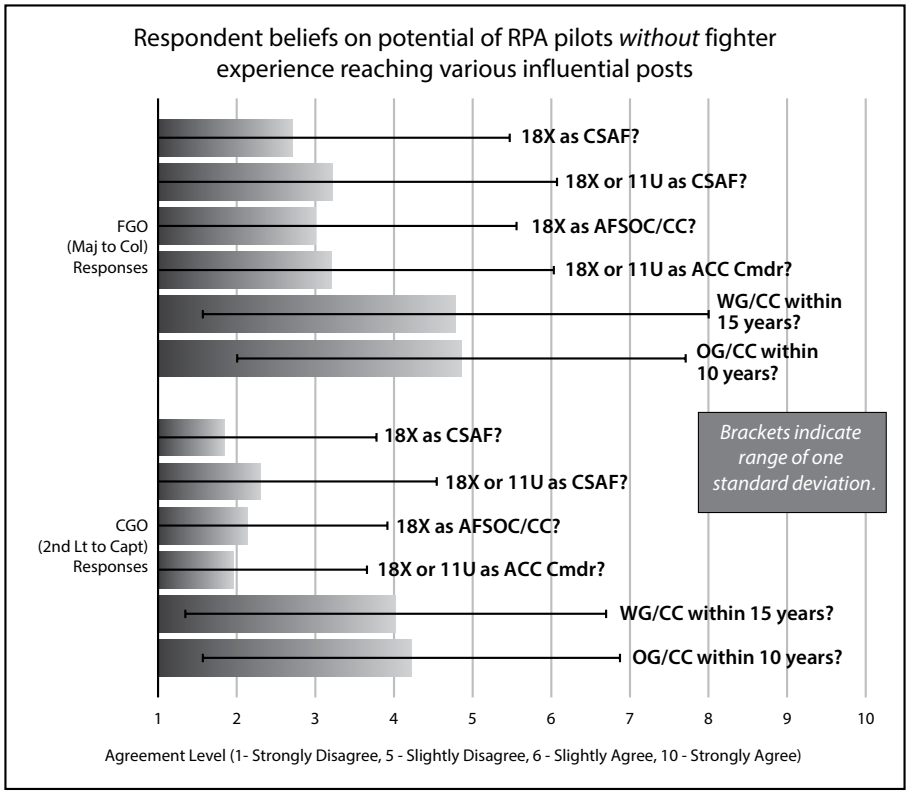

Figure 2. Pessimistic outlooks

18X=RPA-Only Pilot

11U=Pilot Converted to RPAs

ACC=Air Combat Command

AFSOC/CC=Commander, Air Force Special Operations Command

CGO=Company Grade Officer

CSAF=Chief of Staff of the Air Force

FGO=Field Grade Officer

OG/CC=Operations Group Commander

WG/CC=Wing Commander

One pilot reported that an operations group commander at Creech deliberately limited the types of tactical accomplishments that could be included in performance reports.[38] Whatever the intent, the effect was to downplay the contributions of RPA crews and render their reports less competitive than they might have been otherwise. Furthermore, officers encountered irregular behaviors with regard to the

stratifications (rankings) on performance reports that frame promotion and school recommendations. While F-22 operators controlled Holloman—also the home of the MQ-1 and MQ-9 formal training units (FTU)—RPA pilots reported that they received ratings like "# 1/28 RPA Majors" when fighter pilots certified the reports. In the strictest interpretation, that kind of rating is called an "illegal strat" and is akin to being paid in counterfeit currency since a promotion board accepts only certain qualifying key words in recommendations.[39] It is plausible that these kinds of reports were partly responsible for overall low promotion and school selection. One interviewed officer asserted that the behavior, coupled with comments during official performance feedback, constituted deliberate messaging that RPA pilots were "second class citizens" compared to fighter pilots. Respondents used that phrase repeatedly during the author's research.[40] Whatever the subjective sentiments, observed outcomes were that several personnel at the FTU, even an MQ-9 flight examiner with otherwise commendable records, were passed over for selection to major while all F-22 pilots were promoted, many with school follow-on assignments. If the staffing crisis inhibiting the growth of the new airpower perspective were solely a product of overwork at Creech and Cannon AFB, New Mexico, the FTU, with opposite characteristics in almost every respect, might have been a relief valve. Instead, reports of alleged sabotage and discrimination gave members incentive to refuse orders and depart active duty.[41] Survey responses reflect this dim view of Holloman: only 46 percent would accept the assignment, 29 percent would leave the service, and the remaining 25 percent were either ineligible to move or would go strictly because their service contracts obligated them (fig. 3).[42]

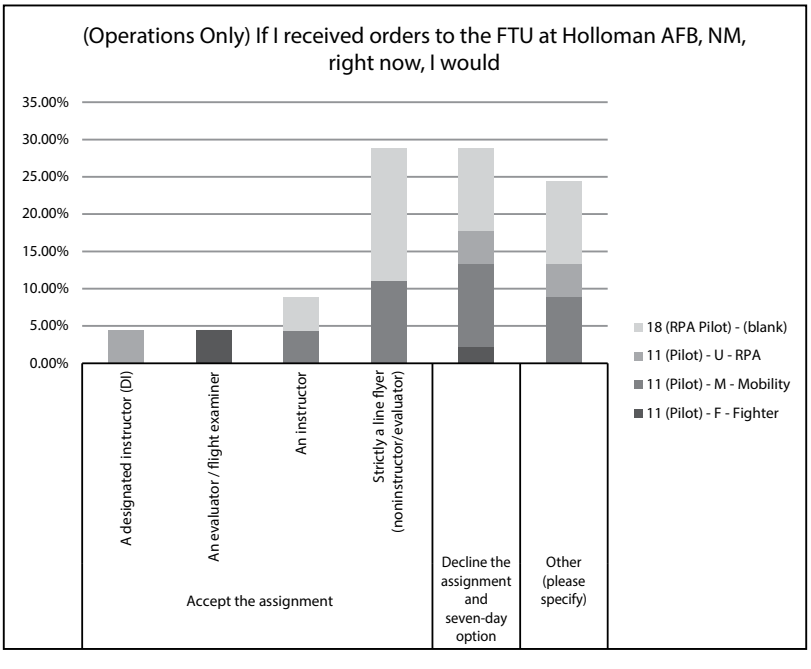

Figure 3. The RPA community's dim view of Holloman AFB

In late 2014, 18X pilots who graduated from training between 2011 and 2013 (about 200 officers) discovered that the Air Force Personnel Center (AFPC) had secretly changed their service commitment dates to extend their required service after it realized they did not have the two years of retention required by policy to force them to accept reassignment to Holloman. These officers petitioned for correction of records and showed the contracts they actually signed but received no response from either AFPC or their chain of command.[43] AFPC destroyed its credibility and harmed that of senior leaders with such unnecessary tactics when it might have simply stated its problem and asked for volunteers. In fact, research revealed that a cohort willing to accept the assignment *does* exist: the subset of predominantly younger officers who are both eager for an opportunity to progress to instructor pilot and who were not exposed to Holloman's internal conflict. The latter fact may indicate some improvement of the FTU's appeal since the F-22s departed. Preserving those gains will likely require that command of Holloman remain with an experienced RPA pilot, potentially complicating proposals to administratively integrate the F-16 training contingent that moved there in 2013.[44]

Given such perceived mistreatment in so many areas, it was unsurprising that surveyed members valued commanders who would be loyal advocates.[45] Between 2012 and 2014, all three flying squadron commanders at the FTU were transplants who kept a "core identifier" in their records of 11F (fighter) or 11B (bomber) rather than redesignating as 11U (RPA). The situation is historically similar at Creech as well. Permanent members of the RPA cadre indicated their belief that they had been "shown the ceiling" and would never be allowed to command their own units because they did not begin their flying careers in an F-16.[46] One exceptional squadron commander with extensive RPA experience and among the first to switch to the 11U identifier made an unfortunate discovery upon assuming command that reinforced this belief. The previous (11F) commander's spreadsheet for stratifying officers had a column that arbitrarily awarded extra credit to those with fighter experience.[47] The behavior was consistent with community perceptions of fighter culture and inspired cynicism: that commander betrayed their trust by quietly propping up fellow members of the "fighter fraternity" and never admitting the action. Such behavior, once exposed, intensified the rift of distrust between the RPA community and outsiders seen as arriving for "drive-through" commander credit.

A fair but contrary hypothesis to explain the lack of RPA pilots taking command of their own units is simply that there are few candidates senior enough to qualify, given the relatively young age of the RPA career field, and that talented officers capable of leading a flying squadron are available in many communities. One F-22 pilot noted a similar pattern as that weapon system began to normalize. He reported that officers from other fighters were selected for command and then sent to F-22 qualification training after the fact. Further, although he noted many challenges associated with mastering a new airframe while learning to command, he did not perceive any resulting cynicism correlating to this article's findings of the RPA.[48] "In-group versus out-group" perspectives might account for the difference in RPAs, an effect Smith observed as a historical marker for impending culture shift.[49] Knowing that fact, individuals entering as commanders must conscientiously assess how their own arrival as outsiders affects organizational dynamics. In the case of the

RPA community, enduring exhaustion and struggling to define its identity within the Air Force, a simple change of identifier can help remove doubts about an incoming commander's prioritization of career ambitions versus leadership responsibilities (fig. 4).

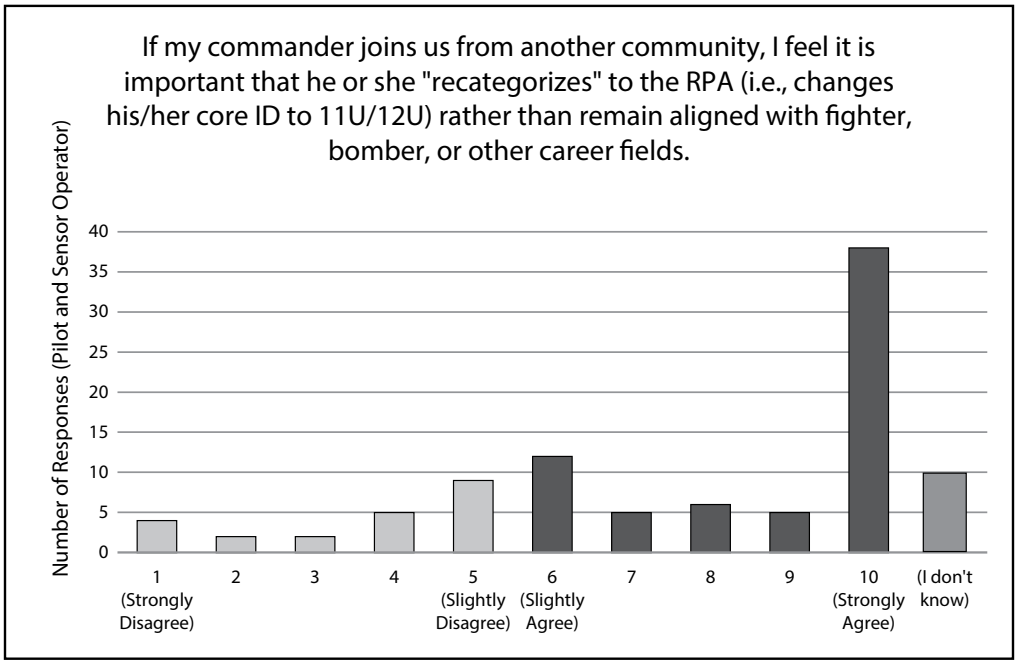

Figure 4. Importance of demonstrated commander allegiance

That struggle for identity and credibility even manifests itself in military exercises. Maj Lewis Christensen, an MQ-9 flight examiner, led RPA crews in a Virtual Flag run concurrently with the Red Flag live-fly exercise in Nevada. Largely ignored by the air operations center, he coordinated with other ISR participants to find relevant work. Employing normal RPA tactics that he teaches at the FTU, his team changed the tide of the virtual war in ways the exercise staff did not expect. Instead of seizing the opportunity to study how the RPA had caused that unforeseen impact, the exercise director voiced frustration and threatened to remove them from the scenario if they did not stop. Christensen stood his ground, saying that if they wanted to remove the MQ-9s, they should do so realistically by using their "red air" to engage them. The director agreed but then found it far more difficult to kill the Reaper than he had imagined: diverting fighters to deal with the RPAs created openings that left his forces vulnerable to counterattack, but ignoring them gave the team operational freedom to inflict equally unacceptable losses.

A comment in text chat from an MQ-9 sensor operator, admittedly delivered insensitively, that they appeared to be "single-handedly winning the war" precipitated

a vocal outrage from the staff and director that culminated during the exercise debrief. Christensen found himself and his team the objects of indignation for doing their jobs to the best of their ability and succeeding in unexpected ways.[50] This episode yields three important observations. First, the Air Combat Command–led exercise dismissed the RPA and refused to believe its capabilities, but personnel with ISR experience immediately saw an armed reconnaissance system as a natural fit for dynamic air warfare. Second, this kind of doctrinal entrenchment that tries to force outcomes to meet preconceived expectations aligns with Smith's indicators of an airpower perspective losing touch with an evolving reality—one ripe for transition.[51] Third, the devastation inflicted by MQ-9s in a tactically sound, realistic manner questions the validity of bifurcating theaters as "permissive" versus "denied." A more realistic view is that any given environment will be extremely fluid and that the wide variety of characteristics across the fleet will compel enemies to make extremely challenging choices when confronting a fully integrated US Air Force. That level of integration will require forward-looking attitudes toward remote and autonomous airpower across the service.

Lockout

The relatively primitive state of equipment, such as the remote cockpits (ground control stations [GCS]) in which the community has logged millions of flight hours, adds some irritation, but frustration with the community's efforts to innovate is a more central concern.[52] Such frustration by itself might have been trivial, but with heavy workloads, impediments to career progression, and a need to improve the tactical credibility of the community to elevate its standing, innovation represented a productive outlet to take charge of a collective destiny. Outsiders are often surprised to find that the GCS is so limited that squadrons must "bolt on" office computers connected to Air Force networks and build needed functionality with desktop applications. Notable RPA innovators in this realm include Capt Brandon Magnuson and Capt Curt Wilson.

Magnuson is a graduate of the US Air Force Weapons School and the 49th Wing's chief of weapons. Wilson, a former Air Force engineer with ties to science and technology circles in and out of the service, is a dual-qualified MQ-1 and MQ-9 instructor pilot who uses his expertise to develop novel concepts for technological progression of the RPA. Magnuson, an avid computer programmer, found his squadron using spreadsheets to calculate tactical holds, studied the problems, and built "MissionX" (mission execution), which receives networked RPA telemetry, visualizes the tactical situation, and builds maneuvering solutions automatically. With minimal training, a pilot can simply turn the aircraft inbound when the left or right turn time is green and follow that colored indication all the way to an on-parameter release (fig. 5).

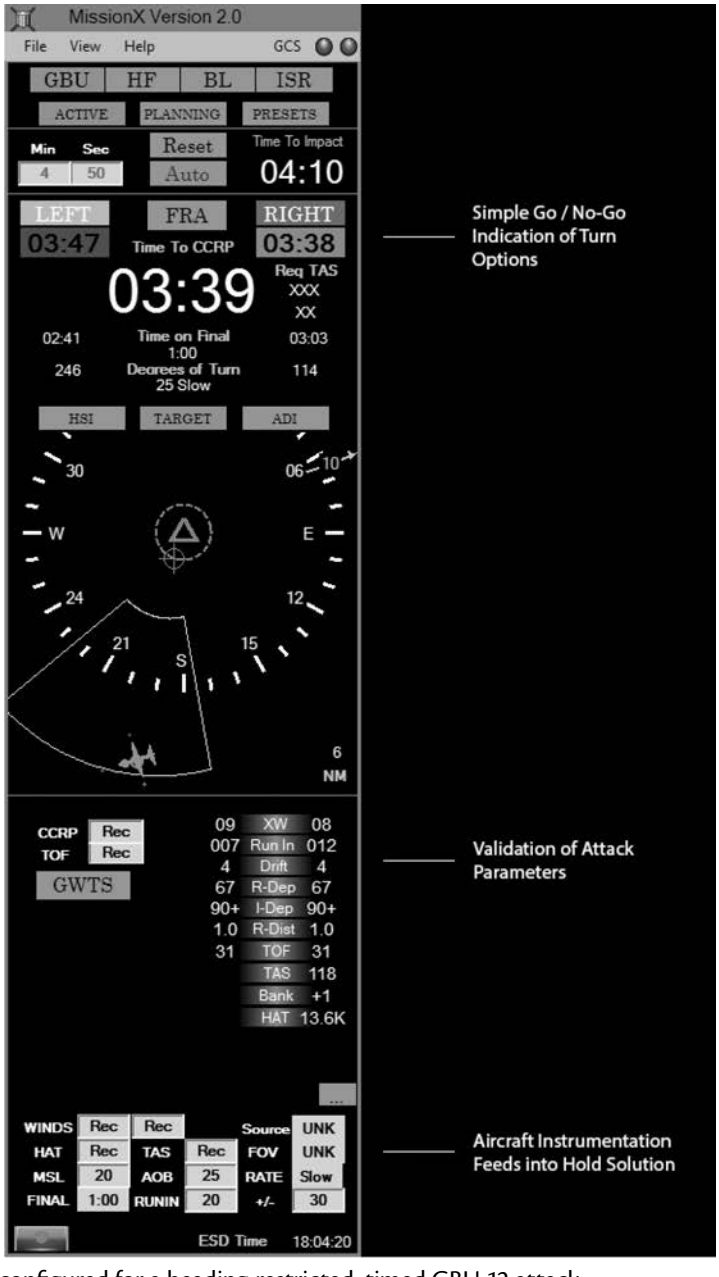

Figure 5. MissionX configured for a heading-restricted, timed GBU-12 attack

Experienced with the processes of defense acquisition, Wilson also sought to remedy the unfortunate state of RPA technical progress that the CSAF acknowledged as late as his March 2015 visit to Creech.[53] Wilson noticed a lack of concepts of operation (CONOPS) with which to map articulated ideas to procurement for the

RPA.[54] In mid-2014, he proposed the Autonomous Mission Planning and Execution (AMPLEX) CONOPS that would negate a 1:1 pilot-to-aircraft ratio requirement by leveraging autonomous capabilities.[55] Aligning Wilson's top-down vision and Magnuson's bottom-up development has important implications. If a person can follow calculated course guidance to hold the aircraft, the next logical step is to let this software directly steer the aircraft's holding patterns. The pilot no longer needs to occupy the GCS and may be collocated with others in an operations center. The pilots would next notice that with many tasks automated, they often have little reason to sit there together; therefore, like emergency service providers, some are "on call" with a predetermined response time, allowing them to do other work and invest time in their Airmen. Although not a singular solution for personnel shortfalls, leveraging autonomy ameliorates the impact and preserves viable manpower levels on a long-term basis. It would also allow one pilot to fly a two-ship formation, effectively doubling sensor and firepower coverage for Army and Marine units in the field if they accepted this packaging construct.

Magnuson faced resistance on the basis of two arguments. First, a sustainment plan had to be in force, other than a coincidental pilot programmer. Second, some leaders feared that if software simplified decision making too much, the construct would cease to be "flying" any longer.[56] Magnuson remedied the first challenge by pitching the idea to a former officer who planned to start a software business, who in turn won a contract to build tools for RPAs. Concurrently, the author, Magnuson, and their colleagues refined software-development methods to rapidly transform code into capabilities. Mining knowledge from Carnegie Mellon's Heinz College, the Human-Computing Interaction Institute, and the US Software Engineering Institute, they created a flow of well-defined activities both to allow military members to participate in design and to simplify statements of work for contractors to do the "heavy lifting" and sustainment of agile software development (fig. 6).

Unfortunately, when these initiatives reached squadron and group leaders, some were intrigued but had no means to take action, and a few saw innovation as a distraction from mission execution. Wilson planned to hand his white paper to a group commander during a luncheon when that commander had responded to someone's unrelated question by saying, "I don't need captains with good ideas—I need captains to be tactically proficient and do their jobs."[57] Leadership views reportedly colored by a traditional "pilots are supposed to fly, not build computer programs to do their flying for them" attitude ultimately derailed these initiatives.[58] Among the tools marginalized was one of Magnuson's designs to pair sensors to mitigate civilian casualties. Individuals enculturated in a legacy fighter-operations perspective had difficulty seeing the extent to which their line of work in the RPA grew to include software management to secure capabilities that affect manpower requirements and tactical flexibility. Pilots might view software development as a "geek" activity, but if it results in two-ship RPA packages arriving armed to the teeth with 22 hours of coverage and improved situational awareness, then the war fighter on the ground will not.

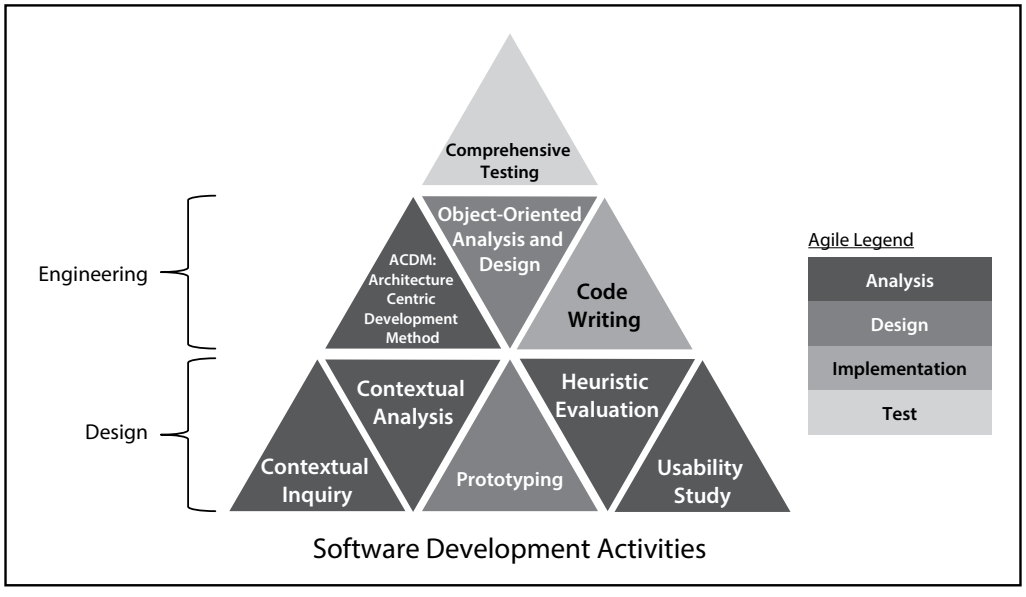

Figure 6. Plug-and-play military/contractor approach to defense software development

Disconnect

In his March 2015 visit to Creech, the CSAF put the onus on the community to generate ideas to establish the way forward for RPAs, unaware that such efforts to take ownership had met with continuous frustration. RPAs demand a global mindset and can be flown from anywhere to anywhere, a fact not lost on their operators pondering why, with a lean logistical footprint that does not even require a local runway or airspace complex, they are still based in remote US locations justified by both. The community has long desired to use the RPA's ability to pass control to another unit to improve flying schedules—a military adaptation of "follow the sun" methods in globalization.[59] In this arrangement—distributed site teaming (DST)—a unit starts operations in the morning, gains control of various aircraft, and passes them to sites in other time zones at the end of its local day. Although such teaming would incur substantial overhead support costs, figures 7 and 8 demonstrate how geographically disbursed units teamed together can provide the same service to combatant commanders without the 24-hour "deployed in garrison" work cycle that has been a negative hallmark of the career field.[60] Arguments against using DST to place permanent RPA wings are in fact problematic for the Air Force: unwillingness to expand ISR provision with RPAs garners resistance from the joint team; additional expansion on current bases further minimizes the number of leadership opportunities available to the community (accelerating departures from active duty); and expansion onto new bases without leveraging time-zone differences is a wasted opportunity.

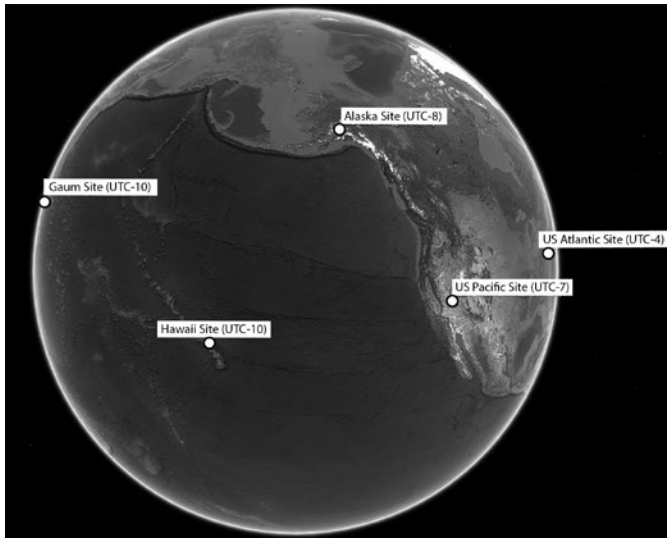

Figure 7. Example of DST—global presence. (From Google Earth image; all copyrighted layers disabled. Derivative image sources [as reported by the software]: Scripps Institute of Oceanography, the National Oceanographic and Atmospheric Administration, US Navy, National Geospatial Intelligence Agency, General Bathymetric Chart of the Oceans, LANDSAT, International Bathymetric Chart of the Oceans, and US Geological Survey.)
UTC=Coordinated Universal Time

Team 1: Pacific, Atlantic, Guam

Zulu Times (hours)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
US Pacific Times	17	18	19	20	21	22	23	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Combat Line 1	C	C	C	C	P												L/G	C	C	C	C	C	C	C
Combat Line 2	C	C	P																L/G	C	C	C	C	C
Combat Line 3	P																				L/G	C	C	C
Combat Line 4																								
Combat Line 5	C	C	C	C	C	C	C	P										L/G	C	C	C	C	C	C
US Atlantic Times	20	21	22	23	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Combat Line 1													G	C	C	C	P/L							
Combat Line 2													G	C	C	C	C	C	P/L					
Combat Line 3													G	C	C	C	C	C	C	C	P/L			
Combat Line 4	P												L/G	C	C	C	C	C	C	C	C	C	C	C
Combat Line 5													L/G	C	C	C	C	C	P					
Guam Times	10	11	12	13	14	15	16	17	18	19	20	21	22	23	0	1	2	3	4	5	6	7	8	9
Combat Line 1					G	C	C	C	C	C	C	C	P											
Combat Line 2			G	C	C	C	C	C	C	C	C	C	P											
Combat Line 3	G	C	C	C	C	C	C	C	C	C	C	C	P											
Combat Line 4	G	C	C	C	C	C	C	C	C	C	C	C	P/L											
Combat Line 5								G	C	C	C	P/L												

Legend	Flying Hours Produced*		
G - Gain Control	Line 1		23
C - Control Aircraft	Line 2		23
P - Pass Control	Line 3		23
L - Launch/Land (LRE)	Line 4		23
Ops Stand-down	Line 5		23

* Excludes Launch/Land

Minimum Crews/Site to Function	6 hr/day	5 hr/day	4 hr/day
Pacific	7	9	11
Atlantic	6	8	9
Guam	7	9	11

Figure 8. Example of a DST schedule concept

With nearly 70 percent of RPA pilots planning to leave, attempts to lead this enterprise like a collection of traditional flying squadrons have failed, even when individual leaders were excellent, because the legacy *airpower perspective* does not account for the complications of a *virtualized cockpit*.[61] Despite improved personnel inflow, failing to adapt will result in the same outcome when ISR demand grows again; thus, organization and policy changes are critical (fig. 9).[62] It appears inconsistent that the most in-demand Air Force specialty—growing while others shrink—finds the majority of its 1,200 pilots crammed into one wing (with contingents in three others) while the fighter enterprise's 2,300 pilots disburse to more than *20 times* as many permanent wings (about 90 pilots per wing).[63] Supporting RPA sustainment without force transformation suggests that the service's leaders still hope that applications for RPAs will subside so they can return to more familiar models of airpower. In 2012 a four-star general with a vested interest in RPAs literally fell asleep in discussions on RPA normalization.[64] The indifference is consistent with institutional preferences; nevertheless, however unappealing to pilots, no evidence suggests that remote and autonomous airpower will fit only ISR contingencies—a spread to other mission areas is overwhelmingly more probable.

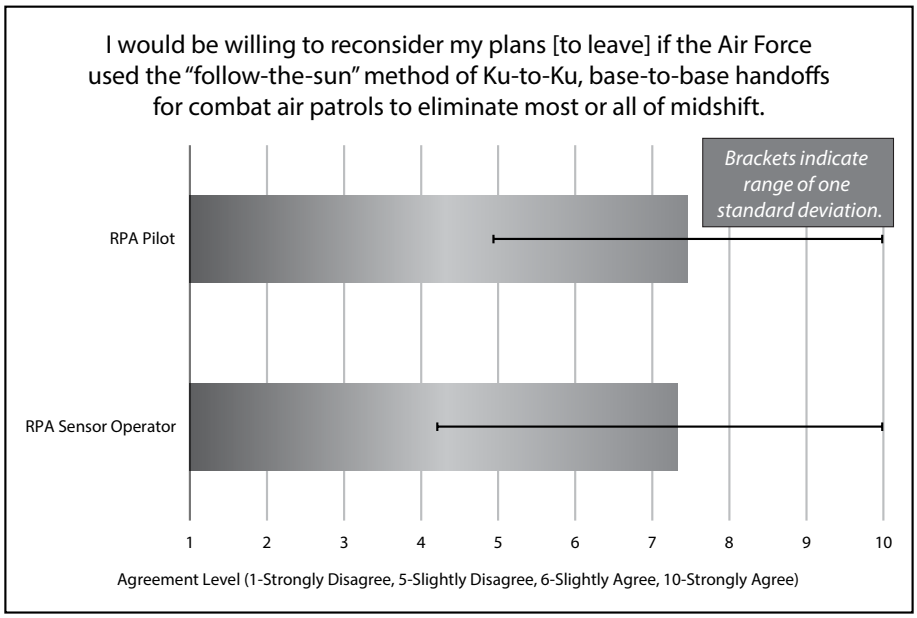

Figure 9. The impact of DST on members committed to leaving

Onward

Institutional resistance makes clear that the technology and concepts demand a safe harbor for development even if their cross-mission proliferation is inevitable. More broadly, ISR requires a home within the Air Force that allows it to perfect the

globalized operations-intelligence fusion perspective that underpins the nation's present security. A home, expressed as a major command, would provide an environment less encumbered by cultural opposition and serve as the center for coherently leading, organizing, training, and equipping global ISR forces. Liaisons attached to the headquarters would sync it with science and engineering communities, academe, and industry, keeping the Air Force current in the most aggressive period of technical growth in the history of the aerospace industry. The force presentation to combatant commands would consist of two numbered air forces: the existing Twenty-Fifth Air Force, containing core intelligence capabilities and specialized reconnaissance platforms, and a reactivated Seventeenth Air Force, predominantly providing theater-level armed reconnaissance (fig. 10).

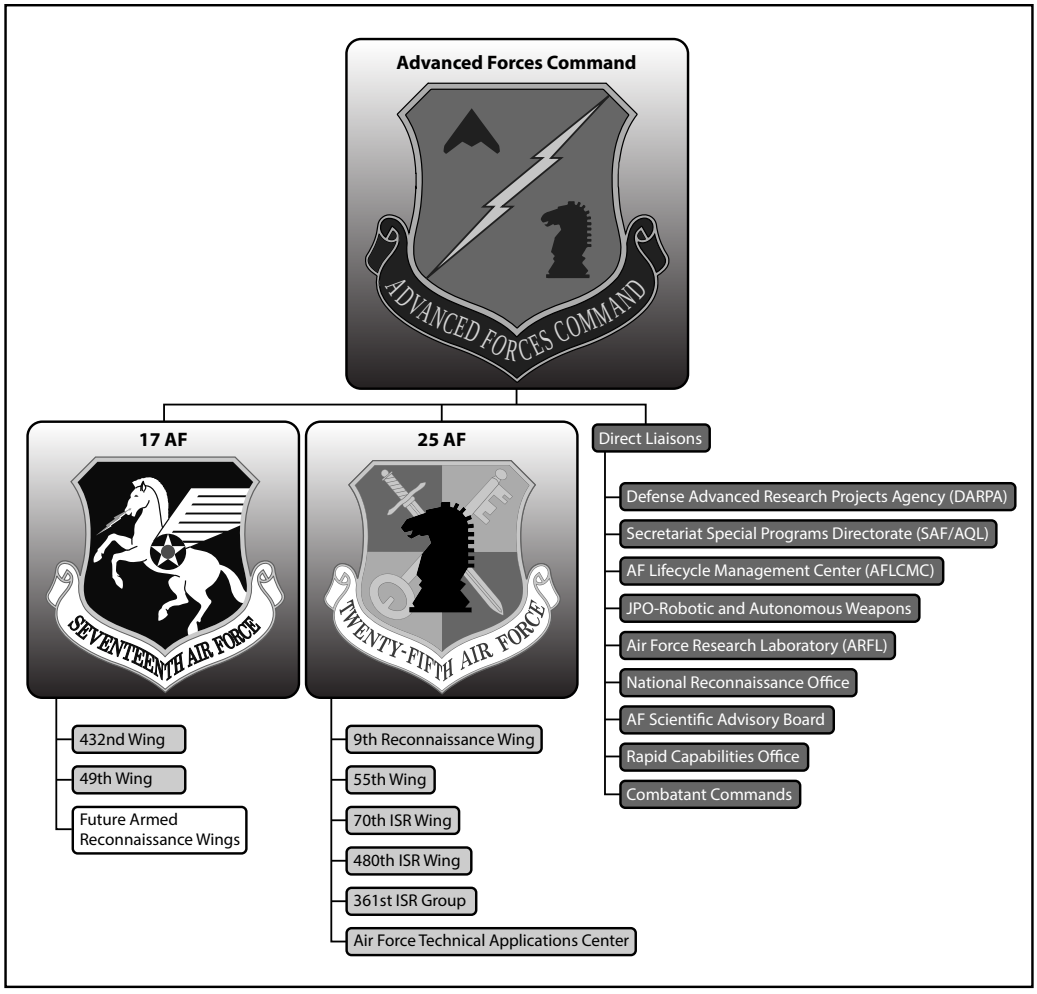

Figure 10. Sketch of a notional "armed ISR" command's initial organizational structure

Even before such reorganization occurs, three categories of recommended policy adjustments would affect the health and viability of the effort to modernize airpower.

Create Equity for the RPA Community

- *Require any rated officer who accepts command of an RPA unit to convert permanently to RPAs.*
- *Establish additional RPA wings: readjust the ratio of squadrons to wings and the number of pilots per squadron* to be commensurate with other flying enterprises (three squadrons per wing and four combat air patrols allocated to each squadron in steady-state operations) in order to level the competitive playing field.[65]
- *Count launch-and-recovery-element flying time* conducted in deployed locations qualified for hostile fire or imminent danger pay *as combat time* rather than combat support.

Improve Retention of Experienced Crews

- *Authorize and fund unit associations and optionally reciprocal personnel exchanges with Guard/Reserve RPA units* to facilitate long-term tactical continuity and expanded basing options. Ensure that these assignments are credited as normal operational flying tours for active duty Airmen without prejudice against their continued career progression.
- *Authorize and fund DST* to stand-up units under the new RPA wings in alternate time zones.
- *Authorize and fund the use of remote split operations to expand RPA FTU operations into geographically separated locations*. This construct is bidirectional: it provides flexibility to place personnel in locations other than bases hosting training ranges, and it facilitates options for the FTU to shift operations from one range to another when weather or airspace availability becomes poor in one location.
- *Count all Guard and Reserve service spent flying or supporting RPA combat lines as "excluded time"* under the Uniformed Services Employment and Reemployment Rights Act.

Provide for the Future of Airpower

- *Petition the Office of the Secretary of Defense to establish a Joint Program Office for Robotic and Autonomous Weaponry* for collaboration on joint requirements, technical standards for interoperability of autonomous vehicles and their control systems, and tactical performance standards. The office should also provide the department's legal and ethical leadership on the use of autonomous weapons and give the secretary of defense a single touch point for all matters relating to the future of robotic and autonomous weapons.

- *Establish an Air Force core function* to account for the pressing need to develop sufficient technological, tactical, and doctrinal sophistication in robotics and computing *to advance the designs of remote and autonomous airpower* for the nation.
- *Authorize competitively selected RPA-rated exchange tours for nonrated officers*. Officers in all career fields will gain more perspective to enlighten decision making in their home communities, and the opportunities to apply airpower will no longer be the sole purview of permanently rated members, leading to a truly universal understanding of what it means to be an Airman.

To do less than right the course of this enterprise leaves the Air Force vulnerable to accusations of stubbornness and strategic myopia and evokes memories of the "incompetence, criminal negligence, and almost treasonable administration" that Gen William "Billy" Mitchell decried almost a century ago.[66] The price of advancement, in this case, is that a previously dominant viewpoint makes room for a new perspective. Thankfully, hope exists that such can happen, evidenced by leaders at many levels setting positive, forward-thinking examples. After having his innovations disregarded, Magnuson taught at the FTU and attended weapons school, influencing thinking at the tactical hub of the Air Force. Christensen stood his ground in a room full of angry officers to prove what his platform could do. Lt Col Scott Frederick, commander of the 311th Fighter Squadron, tells his students about the powerful combination of using RPAs in conjunction with F-16s. After leading the RPA FTU, Col Mark Hoehn was approached about joining the F-35 program, replying, "Thank you, but I'm an RPA guy."[67] Col James Thompson chose Reaper over Raptor to broaden his airpower experience. Col Robert Kiebler stood up during a CSAF-led commander's conference to challenge misperceptions of the RPA. Col Houston Cantwell voluntarily gave up a fighter wing vice-commander assignment to lead an RPA operations group. While earning his MQ-9 qualification, Col Case Cunningham remarked how incredibly lucky he felt to be selected to serve as the next 432nd Wing commander. Though not ready to agree with the secretary of the Navy on the end of human-inhabited fighters, Gen Mark Welsh still stated that he believes in an incredible future for remote and autonomous approaches.[68]

Many of these officers flew fighters, but none of them limited themselves *only* to that experience. They know what Mitchell was trying to tell us when he and his cohort brought airpower into existence: that the *perspective from the air* was the most important lesson of the endeavor. Airpower is about problem solving in multiple dimensions—something that the experience of being an Airman makes intuitive, regardless of the application domain. *That* is what made every maneuver, every intercept, and every attack run satisfying. RPAs require Airmen to think critically in all three of the Air Force's mission domains—not give up airmanship—and they serve as the gateway to a new form of airpower. The RPA community and its shared perspective are threatened by an impending exodus of members who can no longer endure overwork in a force structure seemingly rigged against them, creating a bleak outlook on airpower's next horizon. Several injustices necessitate remediation, yet the correction must be accompanied by forgiveness for injuries, real or perceived. Otherwise, the cycle in which one perspective rises under oppression only to oppress others will continue. The call of airpower and the profession of arms demand

more. The substance of airpower, in all its forms, is too consequential to trivialize with any less.✪

Notes

1. Capt Michael W. Byrnes, "Nightfall: Machine Autonomy in Air-to-Air Combat," *Air and Space Power Journal* 28, no. 3 (May–June 2014): 48–75, http://www.airpower.maxwell.af.mil/digital/pdf/articles/2014-May-Jun/F-Byrnes.pdf.

2. US Customs and Border Protection utilizes Predator B and the Guardian maritime variant. See "Why Does OAM Need UAVs/UAS?," US Customs and Border Patrol, accessed 2 July 2015, http://www.cbp.gov/faqs/why-does-oam-need-uavsuas. There is extensive public discussion on the basis of information collected by investigative journalists on alleged clandestine operations by the Central Intelligence Agency. For a well-formulated overview, see Peter L. Bergen and Jennifer Rowland, "Decade of the Drone: Analyzing CIA Drone Attacks, Casualties, and Policy," in *Drone Wars: Transforming Conflict, Law, and Policy*, ed. Peter L. Bergen and Daniel Rothenberg (New York: Cambridge University Press, 2015), 12–41.

3. Colin S. Gray, *Airpower for Strategic Effect* (Maxwell AFB, AL: Air University Press, February 2012), 33, http://aupress.maxwell.af.mil/digital/pdf/book/b_0122_gray_airpower_strategic_effect.pdf.

4. Regardless of who struck which targets where and under what political arrangements, the net effect has been to nearly cripple al-Qaeda and its affiliates before they reach traditional battlefields and to directly combat their terror campaign. For example, attempted "underwear bomber" Umar Farouk Abdulmutallab and Fort Hood shooter Nidal Hasan, among others, were associates (if not disciples) of Anwar al-Awlaki, but he was unable to train or inspire additional followers because he had been killed by US Predator aircraft. See Nicholas Johnston and Martin Z. Braun, "Suspected Terrorist Tried to Blow Up Plane, U.S. Says (Update 1)," Bloomberg, 26 December 2009, http://www.bloomberg.com/apps/news?pid=newsarchive&sid=aMPCgJ4YFUoM; "Expert Discusses Ties between Hasan, Radical Imam," National Public Radio, 10 November 2009, http://www.npr.org/templates/story/story.php?storyId=120287913; and Jennifer Griffin and Justin Fishel, "Two U.S.-Born Terrorists Killed in CIA-Led Drone Strike," *Fox News*, 30 September 2011, http://www.foxnews.com/politics/2011/09/30/us-born-terror-boss-anwar-al-awlaki-killed/. The US District Court, District of Columbia (Washington), dismissed the case involving Al-Awlaki, countering notions that the strike was illegal or that the federal government went beyond its mandate in targeting militants like Awlaki with direct action. See "Nasser Al-Aulaqi, Et Al, Plaintiffs, vs. Leon C. Panetta, Et Al, Defendants," *Transcript of Motion Hearing before the Honorable Rosemary M. Collyer, United States District Judge*, Docket no. CA 12-1192, Washington, DC, 19 July 2013, https://www.ccrjustice.org/files/Transcript%20of%20July%2019,%202013,%20Oral%20Argument%20on%20Defendants%E2%80%99%20Motion%20to%20Dismiss.pdf.

5. Islamic State press secretary Abu Mosa said in a 2014 media interview, "Don't be cowards and attack us with drones. . . . Instead, send your soldiers, the ones we humiliated in Iraq. We will humiliate them everywhere, God willing, and we will raise the flag of Allah in the White House." Instead, Mosa was shot and killed while attempting to attack a Syrian airfield. Noah Rothman, "That ISIS Guy Who Promised to Raise Islamic State Flag over the White House? He's Dead," Hot Air, 21 August 2014, http://hotair.com/archives/2014/08/21/that-isis-guy-who-promised-to-raise-islamic-flag-over-the-white-house-hes-dead/.

6. "Air Force Taking Steps to Fill Drone Pilot Shortage," *Fox News*, 15 January 2015, http://www.foxnews.com/politics/2015/01/15/air-force-taking-steps-to-fill-drone-pilot-shortage/.

7. "RPA Career Satisfaction Survey," designed by the author and conducted between 2 February 2015 and 30 March 2015, eliciting 114 total responses between RPA pilots and RPA sensor operators. Generalizability of the results varies because the significant subdemographics are not uniform in this heterogeneous career field. For example, pilots might be direct-to-RPA (18X), traditional pilots directly from Undergraduate Pilot Training, or converted from fighter, mobility, or other rated utilization fields. Not all subsets of the population have a sufficient number of responses to generalize results. Fighter (11F) conversions, in particular, received relatively few responses. With respect to direct interviews, in some instances, interviewee names are replaced by numbers and broad demographic details for security reasons or as a condition of providing the interview.

8. Secretary of Defense Robert M. Gates, "Remarks to the Heritage Foundation (as delivered)" (address, Heritage Foundation, Colorado Springs, CO, 13 May 2008), http://www.defense.gov/speeches/speech.aspx?speechid=1240. Some people allege that Gates fired the secretary of the Air Force and chief of staff of the Air Force (CSAF) over concerns of aloofness from present joint challenges and that nuclear surety incidents were "final straw" justifications. For an example of that viewpoint, see Caspar Weinberger Jr., "Gates and the Air Force," Human Events, 24 June 2008, http://humanevents.com/2008/06/24/gates-and-the-air-force/.

9. "[US ICBMs:] Early Developments," Federation of American Scientists, 29 May 1997, http://fas.org/nuke/guide/usa/icbm/early.htm.

10. Lt Gen Robert Otto often makes this point publicly: "In 2006 the Air Force supported 11 RPA Combat Air Patrols (CAPs) and they were able to meet 54% of CENTCOM's [US Central Command's] Full Motion Video (FMV) requirements. In 2014, the Air Force supported 65 CAPS and they were only able to meet 21% of FMV requirements; a net decrease of 33% of requirements met despite a 600% increase in fielded capability." Lt Gen Robert Otto, Air Force deputy chief of staff for ISR, "Envisioning the Future of Battlespace Awareness" (address, AFEI Battlespace Awareness Symposium, Booz Allen Hamilton Campus, McLean, VA, 10 April 2015). See also SSgt Christopher Gross, "Priorities of AF Acquisition Outlined at Symposium," Air Force News Service, 18 February 2015, http://www.af.mil/News/ArticleDisplay/tabid/223/Article/566418/priorities-of-af-acquisition-outlined-at-symposium.aspx.

11. Jeffrey J. Smith, *Tomorrow's Air Force: Tracing the Past, Shaping the Future* (Bloomington: Indiana University Press, 2014), 201.

12. Carl H. Builder, *The Icarus Syndrome: The Role of Airpower Theory in the Evolution and Fate of the U.S. Air Force* (New Brunswick, NJ: Transaction Publishers, 1994), 179–88.

13. Grant T. Hammond, *The Mind of War: John Boyd and American Security* (Washington, DC: Smithsonian Institution Press, 2001), 4–5.

14. In mathematics: Duane Q. Nykamp, "Vectors in Arbitrary Dimensions," Math Insight, accessed 7 April 2015, http://mathinsight.org/vectors_arbitrary_dimensions. In computer science: "The N-Dimensional Array (ndarray)," SciPy.org, accessed 7 April 2015, http://docs.scipy.org/doc/numpy/reference/arrays.ndarray.html. In analytic data warehousing: Ralph Kimball and Margy Ross, *The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling*, 2nd ed. (New York: John Wiley and Sons, 2002), 16–27.

15. There may be several methods for describing the elements of OODA using arbitrary dimensions. For example, it would be helpful to track the percent error between a machine's predictions (or a person's expectations) of a situation and the way that situation actually manifests as a means to assess how well the actor in the system performed the "orient" step of OODA. Some of these measures, such as this "percent error" example, would be lagging indicators although a machine pilot would have a greater chance of processing the learning while flying, whereas a human pilot might have to conduct a debriefing session on the ground to realize where errors occurred and how to formulate methods to prevent them in the future.

16. For an example of machine learning applied to searching high dimensional spaces, see Zhen Li et al., "Learning to Search Efficiently in High Dimensions" (paper presented at the Neural Information Processing Systems 2011 Conference, Granada, Spain, 12–17 December 2011), http://research.google.com/pubs/pub37686.html.

17. Deputy Secretary of Defense Bob Work, "The Third U.S. Offset Strategy and Its Implications for Partners and Allies" (address, Willard Hotel, Washington, DC, 28 January 2015), http://www.defense.gov/Speeches/Speech.aspx?SpeechID=1909.

18. "Northrop Grumman Delivers 1,000th Distributed Aperture System for the F-35," Lockheed Martin, 18 February 2015, https://www.f35.com/news/detail/northrop-grumman-delivers-1000th-distributed-aperture-system-for-the-f-35.

19. Smith, *Tomorrow's Air Force*, 190.

20. Ibid., 167–77. Smith used the term *UAV* (unmanned aerial vehicle) in place of *RPA* but with the same substantive meaning.

21. Builder, *Icarus Syndrome*, 29–37.

22. Smith, *Tomorrow's Air Force*, 169–75.

23. Tyrone L. Groh, "War on the Cheap? Assessing the Costs and Benefits of Proxy War" (PhD diss., Georgetown University, Washington, DC, 2010), 254, https://repository.library.georgetown.edu/bitstream/handle/10822/553084/grohTyrone.pdf?sequence=1.

24. Maj Houston Cantwell, "Beyond Butterflies: Predator and the Evolution of Unmanned Aerial Vehicles in Air Force Culture" (thesis, School of Advanced Air and Space Studies, Maxwell AFB, AL, 2007), 94–95.

25. Survey text-based comment field.

26. Cantwell, "Beyond Butterflies," 104. For an example of discontent with the "Transformational Aircrew Initiative for the 21st Century," which forcibly moved pilots out of fighter and bomber jobs, see Tyler Rogoway, "F-16 Pilots Lament Their Predator Drone Flying Fate in this Rap Video," Foxtrot Alpha, 11 April 2015, http://foxtrotalpha.jalopnik.com/f-16-pilots-lament-their-predator-drone-flying-fate-in-1697200871 (video URL: "One G—Predator Drivers [Once Upon a Time Fighter Pilots]," YouTube, video, 4:34, 1 April 2009, https://youtu.be/K5YD3BZO7Ys). Additionally, the film *Good Kill* (2015) essentially argues that pilots who moved from their previous jobs found killing from a remote platform cowardly and that such a viewpoint was central to their objection to the reassignments. The argument, however, is a red-herring tactic. The cohort members knew that an ethically complex concept in warfare would draw public speculation and imagination, when the most sincere complaint that actually presented was simply that they were frustrated about being taken away from a lifestyle and job they preferred (flying) for sake of an emergent mission need (remote airpower). After viewing the film, one instructor at the RPA FTU described it as "awful, . . . unrealistic, and nothing but the guy whining about not being in his Viper anymore." RPA instructor/field grade officer, informal conversation with the author, 7 April 2015.

27. Cantwell, "Beyond Butterflies," 95.

28. Stephen Peter Rosen, *Winning the Next War: Innovation and the Modern Military* (Ithaca, NY: Cornell University Press, 1991), 105.

29. CSAF roundtable notes. This sentiment is also reflected in an online publication. Lt Col Tony Carr, retired, "Hold the Line: Welsh Tells Creech No Help on the Way," John Q. Public, 27 March 2015, http://www.jqpublicblog.com/hold-the-line-welsh-tells-creech-no-help-on-the-way/.

30. Survey questions scaled 1–10. Chance of nonfighter-background RPA pilot becoming an operations group commander: 96 responses, mean 4.46, standard deviation 2.86. Chance of becoming a wing commander: 97 responses, mean 4.29, standard deviation 2.90. Chance of becoming commander of Air Combat Command (ACC): 98 responses, mean 2.51, standard deviation 2.35. Chance of 18X becoming commander of Air Force Special Operations Command: 99 responses, mean 2.46, standard deviation 2.10. Chance of nonfighter-background RPA pilot becoming CSAF: 99 responses, mean 2.78, standard deviation 2.58. Chance of 18X becoming CSAF: 98 responses, mean 2.27, standard deviation 2.27.

31. CSAF roundtable notes.

32. "3.3.6.1. Combat. *Aerial activity*, engagements, or attacks *conducted by aircraft* against an enemy of the US or an opposing foreign force *when there is risk of exposure to hostile fire*. Aerial activity in support of forces engaged in combat when there is risk of exposure to hostile fire. Combat includes both elements: activity against an enemy or opposing force (or activity supporting forces engaging an enemy or opposing force) *and* [emphasis in original] risk of exposure to hostile fire" (emphasis added). Air Force Instruction (AFI) 11-401, *Aviation Management*, 10 December 2010, 64–65. In the example provided in the article, RPA crews leaving their hardened shelters to operate an armed Predator or Reaper are certainly exposed to the risk of incoming enemy fires—arguably much more so than a B-1 or F-16 operating far above the battlefield. Yet, the crew of a traditional platform logs "combat" time, and the RPA crew logs only "combat support" despite bearing greater personal risk of injury of death.

33. RPA pilot # 1, Air National Guard, interview by the author, 18 February 2015. This officer described having to leave the Guard to resume his airline job since the protections of the Uniformed Services Employment and Reemployment Rights Act (USERRA) would cover deployed work as "excluded time" but had no concept of the member being deployed-in-place. Additionally, Airmen in that unit described how the 24/7 operations cycle was problematic for traditional reservists. USERRA says the employer must hold the member's job, not that it must pay him or her. Thus, when a commander needs a traditional reservist to come in for a night shift of flying, crew-rest requirements stipulated in AFI 11-202V3, *General Flight Rules*, 7 November 2014 (chap. 2, "Flight Readiness"), mean that the member may lose two days of regular day-shift work from his or her civilian employer. Reservists would most significantly benefit from the Ku-to-Ku "follow the sun" methodology to eliminate shift work for this reason.

34. House, *National Defense Authorization Act for Fiscal Year 2013*, 112th Cong., 2nd sess., 2013, HR 4310, sec. 527, http://www.gpo.gov/fdsys/pkg/BILLS-112hr4310enr/pdf/BILLS-112hr4310enr.pdf.

35. Company grade officer count referenced from the author's own performance report from May 2013; total officer count on Holloman courtesy of the 49th Wing staff.

36. United States Government Accountability Office, *Air Force: Actions Needed to Strengthen Management of Unmanned Aerial Systems Pilots* (Washington, DC: United States Government Accountability Office, April 2014), 28–34, http://www.gao.gov/products/GAO-14-316.

37. Results of the author's direct analysis of calendar year 2014 Line of the Air Force Majors Board on a line-by-line, name-by-name basis of 350 officers selected for school. The author then compared selections to Air Force Personnel Center (AFPC) demographics snapshots for captains in the 2005 year group (the group being considered for promotion) between duty positions of 18XX (RPA assignments) and 11FX (fighter assignments) to render an approximate solution: 9/107 = 8.41 percent, minus the F-15 pilot mentioned, 8/107 = 7.48 percent; meanwhile for fighters, 47/195 = 24.1 percent. AFPC itself will not provide this kind of data directly and even has written guidance with a matrix of options to determine exactly how to obfuscate data from the public and from service members. The author and Maj Lewis Christensen worked with Holloman AFB's military personnel section to seek further data sets to validate the initial correlation. On-base personnel were willing to help, but a Headquarters ACC office labeled "A1RI" actively intervened to stop data collection and prevent investigation, stating that only Headquarters Air Force–sponsored research could be conducted. At the time of submission to *Air and Space Power Journal*, a request on the author's behalf from the office of the 49th Wing commander had not produced the requested data sets. After initial submission, however, the research team did at least identify the percentage breakdown of RPA community demographics as of February 2015: 27.5 percent were 11U; 23.92 percent, 18A; 21.82 percent, 11M; 10.30 percent, 18S; 3.65 percent, 11F; 2.77 percent, 11B; 2.77 percent, 12U; 2.44 percent, 11R; 2.10 percent, 11S; 1.22 percent, 11H; and trace amounts reported of 17D, 18R, 12F, 12R, 13S, 62E, 12H, and 11K.

38. RPA pilot # 6 (field grade officer, instructor pilot), interview by the author, 12 July 2015. This officer reported that the group commander recently forbade reporting "strike observation" duties in performance reports. Much of the RPA's workload is reconnaissance, and its participation with the joint team gives fielded commanders the flexibility to use RPAs and human-inhabited aircraft in concert with surface fires and maneuver tactics. Many strikes, including those that target high-profile members of terrorist networks, are possible only with thousands of hours of reconnaissance work by RPAs. The RPA crews often perform all the steps in the kill chain except the final delivery of weapons—if the ground force commander selects another asset for that task. The arrangement is tactically optimal, but accurately representing the RPA crew's significant contribution to the outcome on individual performance reports requires use of the term *strike observation*. The reasons for this particular group commander prohibiting documentation of these events were not clearly communicated to the pilots whose draft reports were sent back to them for editing with the instruction to remove the affected lines.

39. RPA pilot # 2 (field grade officer, instructor/evaluator pilot), interview by the author, 7 April 2015; and direct inspection of records furnished by the member.

40. Ibid.

41. The results of the 2011 majors board drove substantial discussion throughout the community. The author, for example, even got a phone call while deployed to a forward location from his flight commander at Creech. The call was to "set expectations" and prepare RPA pilots for the reality that they could expect Holloman orders unless they found some other job, such as a special duty or controlled tour, and that upon arrival at Holloman, they should expect discrimination based on career-field alignment with the RPA rather than the F-22. The flight commander's only bit of good news was to say that the F-22s' eventual scheduled departure would open up opportunities for continued service.

42. By these estimates, the CSAF's plans to reduce combat flying temporarily and order pilots to Holloman may result in nearly 50 percent attrition among the personnel selected to move. The consequence would be not getting the increase in production desired and further damaging manpower levels in combat squadrons. The community has repeatedly asked to use its remote split operations (RSO) capability to execute FTU operations from other bases and to execute only launch and recovery of MQ-1 and MQ-9 aircraft from Holloman. The result would be a small footprint in southern New Mexico for launch and recovery, with all other instructors based elsewhere, perhaps starting at Kirtland AFB in Albuquerque (four hours north of Holloman). This idea, no matter how repeatedly voiced, was dis-

regarded when higher headquarters, including the secretary of the Air Force, asked for innovations to improve the RPA enterprise. However, the 49th Wing commander staffed an RSO FTU concept briefing in May 2015 to Twelfth Air Force.

43. RPA pilots # 3 and # 4, phone interviews with the author from Creech AFB and Cannon AFB, 7 and 18 March 2015. A set of redacted records showing the specific manipulation was transmitted to the Air Force Research Institute, Maxwell AFB, AL, and is available upon request. On 29 May 2015, while this article was circulating for peer review and was shared with several flag officers, the officers interviewed reported that their service commitment dates had returned to nominal values but with no more explanation than when they were initially tampered with mysteriously. It is unclear who took action on the matter or how since no one in the chain of command or from AFPC could comment.

44. Capt Erin Dorrance, "Holloman Loses F-22s to Fleet Consolidation, Picks Up F-16 Schoolhouse," Holloman AFB, 27 August 2013, http://www.holloman.af.mil/news/story.asp?id=123361243.

45. Survey question scaled 1–10: 97 responses, mean 7.49, standard deviation 2.75.

46. RPA pilot # 3 (company grade officer, instructor/evaluator pilot), interview by the author, 11 January 2015.

47. RPA squadron commander, interview by the author, 24 November 2014.

48. Maj Keegan McLeese, aide-de-camp to the ACC commander, interview by the author, 28 May 2015.

49. Smith, *Tomorrow's Air Force*, 14.

50. Maj Lewis Christensen, interview by the author, 26 March 2015.

51. Smith, *Tomorrow's Air Force*, 159.

52. Survey questions scaled 1–10. Air vehicle: 103 responses, mean 6.37, standard deviation 2.11. GCS: 103 responses, mean 4.38, standard deviation 2.22. Prefer another contractor: 102 responses, mean 7.54, standard deviation 2.27. Statistics on the MQ-9 responses are slightly inflated as a result of those of one officer, who had elected to separate from the Air Force and accept employment at General Atomics; this individual completed a survey and provided favorable scores and remarks about the product that were well outside the norms for the community. General Atomics has in fact built at least two styles of advanced GCSs, but the Air Force will not purchase them. Informal comments from ACC officials and from then-commander Gen Gilmary M. Hostage III in a June 2014 visit to Holloman fit the theme of concern for being "overinvested in permissive [ISR] assets." See General Hostage, ACC commander, "Q&A Session" (address, Holloman AFB, NM, June 2014); and Lt Gen Robert Otto, deputy chief of staff for intelligence, "AF ISR" (speech, Mitchell Institute for Aerospace Studies, 9 June 2014). Audio available at "Mitchell Institute Presentations," accessed 8 July 2015, http://www.afa.org/mitchellinstitute1/Presentations/.

53. Maj Joe Rice made notes on the CSAF's "roundtable" (small-venue format) discussion, cross-validated with other scribes for accuracy, and sent them to his unit's leadership, team members, and other officers unable to attend the event.

54. That pattern is laid out in Gray, *Airpower for Strategic Effect*, 16–17.

55. Capt Curt Wilson, "Leading Next Generation RPA CONOPs Development" (unpublished white paper, 30 June 2014).

56. Capt Brandon Magnuson, interview by the author, 27 March 2015.

57. Capt Curt Wilson, interview by the author, 24 March 2015.

58. Ibid. The argument against advancing software in the midst of a *completely* computerized flight environment is particularly nonsensical.

59. Erran Carmel and Paul Tjia, *Offshoring Information Technology: Sourcing and Outsourcing to a Global Workforce* (Cambridge, UK: Cambridge University Press, 2005), 11–12. Carmel and Tjia highlight that the principal challenge of "follow-the-sun" or "around-the-clock" models in business is that the coordination and handoff of work must be flawless. The standardized nature of military aviation (following published checklists) means that RPA work distributed around various time zones on Earth has an excellent chance of succeeding.

60. The principal costs are additional GCSs and communications infrastructure as well as maintenance personnel who service both.

61. Senate, Committee on Armed Services, *Current State of Readiness of U.S. Forces in Review of the Defense Authorization Request for Fiscal Year 2016 and the Future Years Defense Program*, 114th Cong., 1st sess., 25 March 2015, 42 (line 22), http://www.armed-services.senate.gov/imo/media/doc/15-34%20-%203-25-15.pdf.

62. Survey question scaled 1–10, filtered for 59 respondents who indicated they planned to leave active duty after their commitments were up. Pilots averaged 7.46 with a standard deviation of 2.52, and sensor operators averaged 7.33 with a standard deviation of 3.16.

63. CSAF roundtable notes, referencing the growth of ISR and corresponding resource impact on other missions. Headquarters Air Force (HAF/A1), "Officer Manning by MAJCOM and Base and Grade," report (Washington, DC: HAF/A1, 31 May 2015), sorted for duty AFSC prefixes of 11F and 18A. Wing counts: Lt Col Lawrence Spinetta, PhD, "The Glass Ceiling for Remotely Piloted Aircraft," *Air and Space Power Journal* 27, no. 4 (July–August 2013): 107, http://www.airpower.au.af.mil/digital/pdf/issues/2013/ASPJ-Jul-Aug-2013.pdf. The 432nd Wing at Creech is the Air Force's only dedicated RPA wing, and the 27th Special Operations Wing has one-third of its squadrons dedicated to RPA operations. The 49th Wing is only momentarily majority RPA since some leaders have an interest in trying to realign the newly arrived F-16 mission under ACC. The wing commander's purpose is to reduce duplicate staff and find greater efficiencies (for example, there are two operations support squadrons since F-16s arrived) as well as to be able to tap into all available talent on the base to build the wing staff. That latter piece of the reasoning seemed to indicate to most officers interviewed that RPAs would not be able to maintain control of the host wing at Holloman since they believe the commander and vice-commander are intent on reinstalling fighter pilots in key positions.

64. RPA pilot # 5 (former ACC staff officer), interview by the author, 30 January 2015.

65. Spinetta, "Glass Ceiling," 107.

66. "Mitchell Flays U.S. Army, Navy: Blames Air Disasters on Sheer Ignorance," *San Antonio Light*, 5 September 1925, Home Edition, 1.

67. Col Mark Hoehn, interview by the author, 6 March 2015.

68. Sam LaGrone, "Mabus: F-35 Will Be 'Last Manned Strike Fighter' the Navy, Marines 'Will Ever Buy or Fly,' " US Naval Institute News, 15 April 2015, http://news.usni.org/2015/04/15/mabus-f-35c-will-be-last-manned-strike-fighter-the-navy-marines-will-ever-buy-or-fly; Brian Everstine, "Manned Aircraft Needed for Future Air Force, As Navy Moves Unmanned," *Air Force Times*, 22 April 2015, http://www.airforcetimes.com/story/military/2015/04/22/welsh-future-aircraft-pilots-needed/26178677/; and CSAF roundtable notes.

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